THE FUTURE OF ANTHROPOMETRY.

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The attempt to predict the future of any science is only possible after a review of its past and present history. Fortunately as regards anthropometry, the stages which have marked its development are so well known that only a brief summary need be given here.

In the year 1799, Charles White, a Manchester surgeon, published the results of measurements made by him upon about fifty African negroes in order to determine certain differences between them and European peoples. Since then, an enormous amount of labour has been spent in collecting other measurements. The ratios of head-breadth to head-length, of nose-breadth to nose-length, of leg-length to thigh-length, etc., expressed as so many indices, have been determined upon individuals or skeletons from most parts of the globe.

The averages or means of series of indices obtained from one people have been compared with the averages or means obtained from other peoples. It is unnecessary here to point out the wide differences which have been found to exist for any one index among the different peoples of the world; how, for instance, the average cephalic index, which in the New Caledonian is 70, reaches 85 or more in certain districts of Central Europe, or how the average nasal index rises from 41·9 among the Esquimaux to 60·2 among the Bushman tribes.

A further step in the advancement of anthropometric research was made when attention began to be paid to the values of the individual indices from which these means had been calculated. It was observed, for instance, that a people, which gave an average nasal index of 57·9, contained individuals whose nasal index was less than 49 or greater than 68,[1] or that a people whose cephalic index averaged 77·5, yet contained individuals whose cephalic index was 66 and 85.[2] A study of the extent and frequency of such deviations from the mean was thus initiated. Binomial curves of indices were plotted out; but it was found that, instead of giving a plain, smooth, singly-crested line, they showed many varieties of asymmetry, and almost universally two, three or more peaks or modes. As each peak, of course, implied that individual indices were crowded in greater number at that point than elsewhere in the immediate neighbourhood, these peaks or modes were taken to represent types. Thus arose the art, which is still very widely practised, of dissecting out types from the indices obtained from a group of people,

[1] Shrubsall, *Journ. Anthrop. Inst.*, 1899, vol. xxviii, pp. 100, 103.
[2] Topinard, *Eléments d'Anthropologie Générale*, Paris, 1885, p. 387.

and of speaking, for example, of mesaticephalic, and of brachycephalic types co-existing in any one people under examination. This conception of types is implicitly founded on the hypothesis that at one time there existed races, each of which exhibited a separate type. And so, in consequence of the extreme and irregular variations of individuals from the mean or average of their people, has arisen the familiar modern dictum of anthropologists that at the present day no pure race exists.

Thus far has anthropometry progressed with the task of taking an average of every seemingly useful measurement on every people of the globe. Assuming that she has completed this task, what results has she obtained by her knowledge? Basing her faith in measurement as a sure means of ethnic identification, she has found the variation of individuals from the mean to be so wide, that again and again, even her ablest exponents have been grossly deceived in their attempts to identify ethnologically a bone or bones from the measurements by which the various forms and dimensions of bones are expressed.

It is small wonder that this has resulted in a hopeless distrust of anthropological measurements. Modifications of method have been vainly tried in order to improve this disappointing condition of affairs. One reason for the failure was held to lie in the complex nature of many of the measurements which had been chosen. It was said, for instance, that the comparison of maximum head-lengths among different races is absurd, since the maximum head-length is the expression of several independent variables, *e.g.*, the projection of the occiput and the prominence of the glabella. By another it was suggested that no two bones should be measured together, that the bones composing the skull, for example, should be individually measured, each, perhaps, from its own centre of ossification. Others affected to find the remedy in dispensing with indices, basing their conclusions on absolute measurements only.

There came also the well known endeavour of Sergi to banish anthropometry altogether from the department of comparative human craniology. By now, however, he shows signs of yielding the isolated position which he originally took up as to the utter worthlessness of indices, while he has induced most anthropologists to agree with him as to the ethnological value of the study of the configuration of bones. Need it be urged how mischievous is such an attempt to replace linear or angular measurements by a study of outlines, if based upon the expectation that mathematical considerations may be thereby ousted from physical anthropology? To judge of an outline of face or skull by the eye, to set it down as beloid, ellipsoid, or what not, is to foster an utter lack of reliability in anthropometric results. For a very short experience of Sergi's methods is sufficient to prove how, in practice, the various forms described by him shade insensibly into one another. If we are to know the degree of nearness or of remoteness borne by each skull or bone to the type-forms, is it not clear that these various forms must be expressed in mathematical language? Outlines, of course, are not as simply amenable as lengths and breadths to numerical representation, but that they are ultimately

so amenable must be obvious to every one after a moment's consideration. Indeed, if physical anthropology is to be a science, its results *must* be capable of expression in mathematical formulæ. To this end some of the most interesting of the biological work of the age is trending. The traveller and the student of natural history have had their day. I do not mean to deny that species, varieties, and histological, embryological, and physiological phenomena still await description in the old picturesque fashion. But, generally speaking, the study of living forms is passing from the descriptive to the quantitative aspect, and it is by experiment and observation on biometrical lines that future progress is clearly promised.

In reality, the disrepute into which anthropometry has thus fallen, is very largely due to the perpetuation of methods that cannot be too strongly nor too often condemned. Example after example might be taken where a single average index, obtained from a handful of skulls of one people, is fatuously compared with the average index of the skulls of another people, in order to obtain proofs of ethnic relationship. But I would not for a moment have it supposed that I am here blaming craniologists and travellers for publishing small series of measurements. More data are precisely what is wanted, if they be carefully gathered by means of accepted methods. What we do not want, what has been done more than anything else to bring about the general discredit that embarrasses anthropometry at the present day, is the false reasoning from such slender premises. Let the collector of small material set forth his contribution, but let the material bide its time until sufficient has been collected to serve as a reasonably secure basis for conclusions.

A very slight acquaintance with statistical methods is adequate to convince any one that the already mentioned dissection of a series of indices or measurements into groups or types is apt to be an unwarrantable and fallacious proceeding. The figures obtained in anthropometric work will range themselves about two or more numbers, not only orderly and significantly, because the material of the series is composed of distinct heterogeneous elements, but also accidentally and at random, because the series is numerically insufficient to give a smooth singly-peaked curve. There can be little doubt that most of the many-peaked curves owe their irregularity to the inadequate number of individual measurements which have been taken. A very extensive series, the sufficient size of which can only be determined by statistical methods, must be investigated before deductions of ethnic relationship can be legitimately made.

We return to consider the statement that no pure race exists at the present day. The question at once occurs to us, has a pure race ever existed, and, if so, what are the criteria of racial purity? Take the earliest people of which we have any trustworthy knowledge, the prehistoric Egyptians who lived before 5,000 B.C.; are they a pure race? Those who admit the vast remains sent home by Professor Flinders Petrie from Naqada to represent the people of a single epoch, will turn in vain to Mr. Warren's[1] and to Miss Fawcett's[2] recent memoirs, if they expect

[1] *Phil. Trans.*, vol. clxxxix, pp. 135-227. [2] *Biometrika*, vol. i, 1902, pp. 408–467.

to find that the variation of these Egyptians from the mean type is very considerably smaller than what is met with among modern peoples. Or is the Long Barrow race of Great Britain pure? Dr. Garson, at least, has been able to divide them into two groups. If, on the other hand, racial purity is, and always has been, merely relative, the question suggests itself, to what extent do the members of a fairly pure and of an extremely mixed race differ in the deviation of their skeletal characters from the mean? What, for instance, is the difference in the mean variation of stature between the neolithic Long Barrow men and the Englishmen of to-day? Until of late years, no attempts have been made, save by idle speculation, to solve this and similar problems, which are at the very basis of ethnological arguments. Instead of recognizing that there is hardly any measurement which is not important in questions of racial diversity and relationship, provided that it be used intelligently, people have so far been searching vainly for the philosopher's stone, the ideal test, the infallible measurement. Thanks to the recent work of Professor Karl Pearson, the proper start has at last been made, and it is to be hoped that before long a larger body of workers will appear in the field and considerable headway be gained.

I would suggest that anthropometry might gain by the inauguration of a new study, anthropoidometry. Investigations might profitably be made on some one of the anthropoid apes, and the variations in head and stature measurements, for instance, might be compared according as the apes come from the same, or from different, regions of the world. Indeed zoometry is in the future to be looked on as a valuable helpmate to anthropometry. The study of the variation of offspring under new conditions of climate, and their comparison with the earlier stock, can be made far more accurately upon animals, and the general principles, therefrom deduced, be later confirmed or modified in their application to mankind.

A further study which is beginning to engage attention is the dependence of the variation of one character upon that of another. No one supposes that a dark skin is the *sine quâ non* for acclimatization to tropical condition; the increased pigmentation appears to be correlated with certain unknown physiological changes by which that end is attained. So it is with other variations in bodily form. A greater head-breadth is doubtless correlated with a diminished head-length, a greater head-length with a longer face-length, a greater head-height with a diminished head-breadth, a larger set of teeth with a more projecting jaw, a taller stature with an altered ratio of the length of thigh to length of shin. But we have yet to discover how far such correlations vary in the case of different peoples.

We shall some day have material sufficient to determine the evolutionary changes undergone by a people fixed in a given country. The attempt has already been made for Egypt and Great Britain.[1] If the results are accepted,[2]

[1] *Biometrika, loc. cit.*, p. 433.

[2] See however, *Man*, 1903, 13.

they show the possibility of extraordinarily rapid alterations within a comparatively short space of time.

We have also to study the effects of cross-breeding between the various peoples of the globe. Anthropometry has yet to determine to what extent the offspring is fertile, how far the characters of the parents are inherited, how often they are blended, or are alternative (*i.e.*, exclusive), whether the characters of one parent are ever irretrievably lost (the so-called false hybridism of Millardet), whether the offspring ever exhibits totally new characters, and how far such diverse characters of the offspring are permanent.

Through the initiative of Mr. Francis Galton, anthropometry has begun to investigate other problems which must ultimately be of ethnological interest, *e.g.*, whether dark-eyed or tall women bear more children than the fair-eyed or short, whether brothers are more alike than sisters, whether inheritance is more marked in the male or in the female. We have here opened out the whole subject of heredity which ultimately must enter into every branch of physical anthropology. Those who are familiar with the various claims of Mendel and his successors will recognize what a wide field of research is here possible. Into this province I cannot attempt to enter. So much must first be settled by zoologists who can work under simpler and experimental conditions, before anthropometry can profitably apply herself to the subject.

Indeed, turn which way we will, we see that ultimately anthropometry must ally itself with the study of the measurements of other living forms. Biometry is at present in its infancy. It has the advantage of seeing into what errors its elder sister Anthropometry has been led by arguments based on insufficient data. In the future we may behold one united science concerned in the quantitative investigation of the phenomenon of life.

Along what lines this investigation will go I have attempted to sketch out to you. If in so doing I have been able likewise to indicate the present pitfalls which are to be avoided, and some of the main directions in which, at this moment, anthropometry may profitably be employed, I shall feel that I have not laboured in vain. Anthropometry has become well nigh sterile by its persistence in one sole line of research after racial averages. Its activity can only be revived by the infusion of new blood, the adoption of improved methods, the pursuit of new problems. The collection of sufficient material is open to all who are possessed of the requisite patience and accuracy. Accuracy can only be obtained by faithful obedience to agreed bases of measurements, and by such reductions of the personal equation as may be brought about by occasional meetings of those engaged in anthropometric work in order to discuss and actually to compare their several procedures. The subsequent treatment of the material may require a mathematical and statistical training, the opportunities for which, although even now presenting little difficulty, must as surely increase in the future as the demand for them will surely become greater.

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